Consolidation and competition. The case of the Argentine banking industry *

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Abstract

The Argentine banking industry has experienced increasing consolidation during the last decade. On the one hand, it can be argued that this has resulted from cost economies, perhaps associated with technical change. But on the other, it can also be argued that increased concentration in this industry may allow the exploitation of market power in the input (deposits) and output (loans) markets. These issues are addressed in this study using bank-level data for Argentine retail banks over the period 1993-2000 to estimate a cost-function based model incorporating deposits- and loans-market pricing behaviour. The results provide evidence of market power in both the market for loans and deposits and also the presence of significant cost economies, which vary over time. The findings also show an increase in consumers' surplus and banks' profits over the period but suggest the potential for additional benefits to consumers from a reduction of market power or a further expansion of bank activity level.

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1. Introduction

The banking system has traditionally experienced a reduced role within the Argentine economy because of financial repression, political uncertainty and macroeconomic instability. But the financial liberalisation of the nineties, the convertibility plan and associated major structural reforms such as the liberalisation of trade, the adjustment of public finance, privatisation and the renegotiation of the national debt all contributed to reducing macroeconomic instability and to stimulate recovery. These reforms prompted the financial system to grow in a more competitive environment which in turn led to changes in the structure of the banking sector towards greater consolidation. As a result of this process, which accelerated after the Mexican crisis of 1994, the number of banks almost halved during the 1990s while concentration of deposits and loans among the largest institutions increased sharply.

These significant changes raise important policy concerns. On the one hand, it can be argued that a high level of concentration could allow banks to take advantage of oligopoly and oligopsony power by raising the interest rate on loans and reducing the rate on deposits leading to excess profits. On the other hand, the increasing size of banks may be indicative of the potential for scale and other types of economies, which could allow larger firms to increase their cost efficiency. These efficiency gains can be transferred to borrowers and depositors in the form of higher deposit and lower loan interest rates if competition limits the exploitation of market power. Thus, modelling and measuring the market and cost structure of the banking industry requires detailed consideration of the oligopoly and oligopsony nature of the market as well as the cost structure of the industry. Such a model facilitates the evaluation of whether any benefits from efficiency gains have been translated to customers or if exploitation of market power and cost economies has instead resulted in excess profits.

Previous studies present several drawbacks. First, most studies have focused on the measurement of market power without consideration of the cost structure. Second, studies have basically relied on aggregate data, which are limiting for at least two reasons. On the one hand, results based on the assumption that firms have identical cost functions may be misleading if firms are heterogeneous. On the other hand, difficulties emerge if the industry is represented in terms of an oligopoly and oligopsony rather than monopoly and monopsony framework, as this requires modelling individual decision-making units. Third, deposits have frequently been considered as inputs, but the potential for oligopsony power in this market has been ignored. Finally, most studies analyse market power at the nation-wide level, thereby overlooking the problems associated with the notion of the relevant banking market.

This study investigates the market and cost structure of the Argentine banking industry using a panel data set for the period 1993-2000. The focus of the analysis is on the measurement of market power in both the loans and deposits markets recognising the effect of scale economies. Towards this aim it uses a cost function-based model to characterise the cost structure of retail banks along with profit maximisation conditions over loans and deposits, and it considers regional and firm differences as well. The paper is organised as follows. Section 2 presents a brief overview of the Argentine banking sector while section 3 reviews related studies regarding the measurement of market power in this industry. Section 4 introduces the model and section 5 presents its empirical implementation, the data sources and discusses the results. Finally, the last section summarises and presents the conclusions.

2. The Argentine Banking Industry in the Nineties

At the beginning of the last century Argentina possessed a well-developed financial system with significant financial savings in an economy of low inflation and persistent growth.[1] Banks played a major role in economic development allocating savings to investment. Capital was very mobile, the country was remarkably well integrated to the international financial market and domestic interest rates and prices were close to world levels. However, the negative impact of the Great Depression followed by the second World War and the failure of *import - substitution policies,* implemented during the fifties until late seventies, led the country to a long period of macroeconomic instability. Disequilibirum in the balance of payments became persistent and fiscal deficits financed with money creation provoked high inflation rates and recurrent pressures on the exchange rate, intensifying the external crisis. The usual correction via devaluation, contraction in monetary supply and reduction in public expenditure overcame the crises, but generally led to recession. The recovery of economic activity created inflationary pressures and on the exchange rate leading once more to imbalances in the external and fiscal sectors.

At the end of the sixties several measures, aimed at re-establishing macroeconomic stability, were implemented in order to combat the balance of payments disequilibirum, to eliminate the fiscal deficit and to control the money supply but were also accompanied by a reduction in tariffs aimed at opening of trade. Unfortunately, these measures led to a major crisis given the fragile and unstable macroeconomic context, financial deregulation aggravated monetary

[1] The M3/GDP ratio, a measure of financial depth, was at 50-60%, the average annual inflation rate was 1.8% while the GDP growth averaged 3.9% annually over the period 1900-1940 (Véganzonès and Winograd, 1997).

instability, caused an additional decline in financial intermediation and led to a slowing down in GDP growth. By the mid-1980s production was stagnant, the monthly inflation rate had exceeded thirty percent and fiscal deficit represented one eighth of GDP. This period was also characterised by a "desindustrialisation" of the country, a strong capital outflow and a steep increase in foreign debt. In this context, the government implemented the *Austral Plan* intended to control inflation by fixing prices, wages and the exchange rate, to adjust fiscal imbalances and to design an active monetary policy oriented towards the control of money supply. However, the adjustment of prices, wages, tariffs and the exchange rate, the government pressure on interest rates and the need to attend the foreign debt services, the balance-of-payments imbalances and the expansion in money supply sharply increased the fiscal deficit, reduced activity levels and generated a hyperinflationary process. [2]

The new government that took office in 1989 set out an ambitious privatisation programme, adopted major structural reforms such as trade liberalisation and adjustment of public finance, renegotiated the national debt and implemented the *Convertibility Plan*. These measures were complemented with the lifting of controls on interest rates, the deregulation of the banking sector and the relaxation of entry barriers. As a result, the performance of the Argentine economy improved and experienced reduced macroeconomic instability: GDP increased at an annual rate of 5.5% throughout the first five years of the decade (although growth rates have been volatile since 1996), fiscal deficit which had reached 3% of GDP was virtually eliminated and annual inflation rates as measured by the consumer price index fell from three digits to one (although unemployment and foreign debt increased, and the trade balance surplus became negative).[3]

The effects of economic recovery and financial liberalisation had a significant impact on the functioning of domestic financial and credit markets, basically characterised by an increase in the degree of monetisation and an improvement in the credit volume.[4] In concurrence, the new Central Bank Charter aided the recovery, modernisation and development of the financial sector, for at least two reasons. Firstly, because it constrained rediscounting and forbade the issue of bank notes and the granting of loans to the public sector. Secondly, as it allowed the elimination of restrictions on deposits, the reduction of minimum reserve requirements and the authorisation of branches of foreign institutions. In this context the Central Bank improved the regulation and supervision of capital and reserve requirements and the inspection of financial entities through the Superintendence of Financial Institutions. More severe norms concerning

[2] During the period 1940-1990 the average M3/GDP ratio was 15%, the annual inflation rate averaged 80% and the annual GDP growth rate was around 3% (Véngazonès and Winograd, 1997).
[3] While in June 1989 the consumer price index increased 200%, between December 1992 and 1993 it raised only 7,4%.

capital adequacy, diversification of credit risks, provisions for non-performing loans and minimum auditing standards were adopted, though in some cases they became stricter than those defined in the first version of the Basle Accord.

Table 1

Evolution of the number of banks in Argentina

Type of bank	December 1993	M&A	R	T	P	A	December 2000
Public	31	-2	-1	1	-14	0	15
- National	3	0	0	0	-1	0	2
- Regional	28	-2	-1	1	-13	0	13
Private	138	-63	-27	3	14	9	74
- Domestic	120	-61	-27	4	14	6	56
- Foreign*	18	-2	0	-1	0	3	18
Total	169	-65	-28	4	0	9	89

Source: Own calculations based on BCRA. M&A: mergers and acquisitions; R: revocations; T: transformations; P: privatisations; A: authorisation of new entities. * Only includes branches of foreign banks. Banks controlled by foreign owners but registered in Argentina are considered domestic.

Consequently, the reforms implemented throughout the decade of the 1990s led to liquidations, mergers and acquisitions and also to the entry of large foreign institutions, which prompted a constant process of consolidation that accelerated during the Mexican crisis of 1994. Several significant transactions took place between 1996 and 1998 whereby British, Canadian, French and Spanish financial institutions, among others, acquired and later merged with many domestic banks. These new entrants added to several existing foreign banks including Citibank, Bank Boston, ABN Amro and Lloyds. As a result of this process, the number of banks dropped from 169 to 89 between 1993 and 2000, as Table 1 shows. The 28 liquidations and the 65 mergers and acquisitions, almost all of them among private banks, may explain this reduction in the number of institutions. The deficient performance of public banks, the reduced government assistance and the new Charter allowing the Central Bank to provide funding to provincial banks only in situations of transitory illiquidity led to the privatisation of almost half of the 28 public regional banks operating in 1993.

Despite the noteworthy reduction in the number of institutions, financial intermediation significantly increased as deposits and loans rose from $48.2 and $48.1 to $85.9 and $77.6 billions respectively, with an impressive jump in the number of accounts, as Table 2 shows. Concentration, as measured by either deposits or loans, also increased sharply. The Herfindhal Hirschman Index (HHI) estimated for deposits increased noticeably but it remained low in

[4] The M3/GDP ratio raised from 5.6% in 1990 to 18.9% in 1994 (Burdisso and D'Amato, 1999).

absolute terms, going from about 521 to 699 over the entire period.[5] This tendency towards increasing concentration could be explained by the mergers among large institutions that tended to increase the inequality in the size distribution of banks. As Table 2 shows, large banks increased their market share in deposits from 86.1% in 1993 to 93% in 2000, while medium and small-sized institutions lost 5.4% and 1.2% of the market in deposits over the period. These figures also show that public banks lost their market share to private institutions in the deposits market mainly due to the privatisations of regional public banks mentioned above. The high levels of interbank rates during the financial Mexican crisis and the depletion of the *Convertibility* could have also contributed to this decline since the interbank market represented an important source of funding for medium-, small-sized and regional banks.

Table 2

Measures of market structure and activity level

Measure	1993	1994	1995	1996	1997	1998	1999	2000
Number of banks	169	167	127	121	116	103	93	89
Volume (billion $)*								
Loans	48.1	557	52.7	56.9	66.4	81.7	81.1	77.6
Deposits	48.2	49.9	44.8	53.6	69.7	83.1	84.5	85.9
Number of accounts (million)								
Loans	4.9	5.0	4.5	5.5	7.5	9.6	9.8	10.2
Deposits	7.8	9.1	9.1	10.1	12.7	16.8	18.3	19.1
Concentration **								
HHI	520.6	431.2	562.5	543.0	584.4	664.7	675.3	699.2
Market share (%)**								
Large	86.1	84.6	89.1	88.5	87.9	91.7	92.3	93.0
Medium	11.5	12.8	9.3	9.7	9.7	7.0	6.7	6.1
Small	2.4	2.6	1.6	1.9	2.4	1.2	1.0	0.9
Public	42.6	39.4	39.5	36.4	34.2	35.2	34.4	34.0
Private	57.4	60.6	60.5	63.6	65.8	64.8	65.6	67.0

Source: Own calculations based on BCRA. * Constant pesos December 2000. ** Deposits.

The level of interest rates as presented in Table 3 suggests that the intermediation spread has been significant over the period, although it declined from 13.8% in 1993 to 11.2% in 2000.[6] Those figures also show that interest rates significantly rose during the Mexican crisis, dropped to lower levels than their initial ones and then increased again. As a result, at the end of the

[5] The HHI of concentration is defined as the sum of the squared market shares of all banks in the market. The formula is $HHI=\sum s_j^2=(v^2+1)/N$, where s_j is the market share of bank j, N the number of banks in the market and v the coefficient of variation of banks' market shares. The HHI synthesises information on both the distribution of market shares and the number of banks in the market. By construction, the HHI has an upper value of 10,000, in the case of a monopolist firm with 100% of the market, and tends to zero in the case of a large number of firms with small market shares.

[6] The intermediation spread is simply measured as the difference between the interest rate on loans and that on deposits.

period the interest rate on deposits equals its initial level while that on loans is one sixth lower than its original value. The efficiency ratios suggest a clear improvement over the entire period. On the one hand, they show a sustained decrease in operating expenses as a proportion of total assets from 9.04 to 3.23 (the reduction in the number of employees as well as in wages seems to be one of the main reasons that explains this tendency). On the other, deposits per employee almost tripled during the period suggesting an increase in the degree of bancarisation and in labour productivity. Notwithstanding those changes, profitability, measured by returns on equity or returns on assets, shows no significant improvement. The low levels observed at both the beginning and end of the period could be explained by the fact that the increase in the cost of money provoked by the Mexican crisis first and the depletion of the *Convertibility* later, could have compensated for the cost economies brought about by the increase in the activity level.

Table 3

Evolution of financial indicators (%)

Indices	1993	1994	1995	1996	1997	1998	1999	2000
Interest rates (annual)								
Deposits*	6.4	5.6	7.7	5.7	5.5	5.8	6.0	6.4
Loans*	20.2	20.8	23.1	18.0	16.3	16.6	17.6	17.6
Call money	6.3	7.3	9.0	6.1	6.5	6.7	6.6	7.9
Economic efficiency								
Operating expenses / Assets	9.04	6.10	5.76	4.67	4.31	3.88	3.85	3.23
Labour expenses / Assets	5.37	4.59	4.35	3.52	3.20	2.86	2.86	2.43
Deposits/Employee (thousand $)	308	410	377	474	588	724	824	836
Profitability								
Profit / Equity (r_{OE})	0.84	1.20	-3.44	2.40	4.86	2.79	1.82	-0.43
Profit / Asset (r_{OA})	0.15	0.18	-0.51	0.32	0.60	0.29	0.19	-0.04
Net interest income / Assets	8.41	7.25	7.40	4.98	4.17	4.13	4.11	3.31

Source: Own calculations based on financial statements. *Average of interest rates on deposits (loans) in domestic and foreign currency, weighted by the volume of deposits (loans).

3. Previous Studies

The *traditional approach* to the analysis of market power is based on the structure-conduct-performance hypothesis (SCP). The conceptual basis of this paradigm, due to Mason (1939) and Bain (1951), basically states that high levels of concentration (structure) facilitate the adoption of collusive behaviour and thus the setting of higher prices and reduced output levels (conduct) ultimately leading to higher profitability (performance). Cowling and Waterson (1976), Dansby and Willig (1979) and others demonstrate that there are some market conditions under which the hypothesis is valid. In contrast, several economic theories challenge the realism of those specialised conditions and show that the structure-performance linkage can disappear under alternative assumptions. For example, the theory of contestable markets describes one set of conditions that yield competitive outcomes even in concentrated markets (Baumol et. al., 1982); another example is the theory of trigger price strategies which suggests one means by which collusive behaviour may be sustained among arbitrarily many firms (Friedman, 1971).

Empirical studies based upon this hypothesis usually explore different relationships between structural concentration measures and profit margins or price levels. In general, these studies seem to provide support for the structure-performance linkage but methodological and other flaws have permeated many of such works. Gilbert (1984) and Weiss (1989) provide good summaries of profit- and price-concentration studies in banking while Demsetz (1973), Smirlock (1985) and Kimmel (1991) present some methodological criticisms. More recent studies such as Kurts and Rhoades (1991) and Berger (1991, 1995) try to fix these flaws but provide limited support for the structure-performance relationship in banking. It therefore becomes evident that a lack of strong theoretical foundations and mixed empirical results motivated the search for alternative methodologies to analyse market power.

An *alternative approach* to the analysis of market power, based on more sound microeconomic foundations, directly explores the behaviour of output or price instead of relying on an observation of market structure. More precisely, this approach assumes that firms set prices or quantities in order to maximise profits and that such a decision is based on cost considerations and on the degree of competition in the market, which depends on demand conditions and also on the characteristics of interaction among firms (see Iwata, 1974; Appelbaum, 1979, 1982; Gollop and Roberts, 1979). Then, if the inverse market demand is given by $p=p(Q,z)$ where p is price, Q market output and z a vector of other shift variables, an effective marginal revenue function can be defined as $MR=p+\lambda/\eta$ (where η is the price semi-elasticity of demand and λ is and index of market power).[7] Next, the equilibrium condition that the industry (or the firm) sets its marginal revenue equal to its marginal cost can be presented as $p=MC(Q,w)-\lambda/\eta$ (Bresnahan, 1982).[8, 9]

[7] Under the assumption of homogenous products and quantity setting firms.

[8] The parameter λ has come to be called the conjectural variation, which denotes a firm's anticipated response by its rival(s) to an output change, even though the parameter has no essential connection with conjectures or expectations as such. Indeed, as noted by many authors, the conjectural variation is a valid parameterization of any type of oligopoly equilibrium, whether or not it is assigned the traditional conjectural interpretation (Bresnahan, 1989).

[9] This method involves using historical data to estimate market demand, production or cost functions along with pricing equations derived from profit maximising conditions, whose parameters allow inference of the degree of market power. Then, if data for each bank in the market are available and a complete model including separate equations for each bank in the industry can be estimated, then, as λ_i moves farther from zero, the conduct of firm i moves farther from that of a perfect competitor. If only aggregate data for the banking industry is available, the equilibrium condition is inferred from aggregate

This methodology has been applied to Uruguayan banks by Spiller and Favaro (1984) and Gelfand and Spiller (1987), to samples of US banks by Shaffer (1989) and Shaffer and DiSalvo (1994), to Canadian banks by Shaffer (1993), to Finnish banks by Suominen (1994), to Norwegian banks by Beg and Kim (1994), to Italians banks by Angelini and Cetorelli (1999), to European banks by Neven and Roller (1999) and Shaffer (2001) and to Israeli banks by Ribon and Yosha (1999). Many such studies find competitive conduct at the overall bank level (even though banking markets in these studies are highly concentrated), while others provide evidence of some degree of market power among banks in the industry. However, these studies have been somewhat hampered by limitations of data and methodology.

Most of these studies rely on *aggregate industry data* (due to data constraints), which are limiting for at least two reasons. Firstly, most studies are based on the assumption that firms have identical cost functions, which may lead to misleading results, if firms are heterogeneous. Neven and Roller (1999) try to fix this flaw and estimate a model under the assumption that marginal cost functions differ across firms. Secondly, because the industry is represented in terms of monopoly rather than oligopoly framework since the latter requires modelling individual decision-making units. In addition, most existing studies analyse market power at the *nation-wide level* (in part due to the above mentioned data constraints), thereby overlooking the problems associated with the notion of relevant banking market, generally considered of a relatively narrow size. Angelini and Cetorelli (1999) separates banks according to their prevalent geographical are of business and find differences in market power among regions.

While only a few studies in this methodology follow the production approach for the definition of outputs and inputs most of them adopt the intermediation approach. This view describes banking activities as the "transformation" of money borrowed from depositors into money lent to borrowers and thus considers labour, physical as well as financial capital (deposits and funds borrowed from financial markets) as inputs while the volume of loans and investment outstanding represent outputs. In general, banks are assumed to be *price takers in the inputs markets*, but if banks have market power in deposits the results may be biased. Ribon and Yosha (1999) appear to be the only to consider the possibility of oligopsony power in the deposits market and find that a certain degree of market power in this market seems to exist.

In view of the limitations of empirical studies about market power in banking and also in order to analyse the impact of cost economies on market power, the next section presents an alternative model based on Morrison (2001a, 2001b), that simultaneously analyses market

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(demand and/or cost) functions and the parameter λ indicates the industry average (λ=0 indicates the market is competitive, λ=1 denotes a monopoly market while with n identical firms playingCournot, λ equals 1/n).

power and cost economies using a cost function-based model.[10] This model consists of a cost function along with pricing equations derived from profit maximising conditions, and allows costs to differ across firms and regions and to measure oligopoly and oligopsony power along with cost economies.

4. The Model

The basis of the model is the established principle that, in equilibrium, profit-maximising firms will choose quantities such that marginal cost equals their perceived marginal revenue, which coincides with the output price under perfect competition but with the industry's marginal revenue under perfect collusion. In the input market, firms will choose the quantity that corresponds to the equality between the marginal factor cost and its value marginal product which in a perfectly competitive market coincides with the input price while in a pure monopsony equals the firm's marginal factor cost. In this way, characterisation of market power depends on the cost structure because it involves comparing the price of the output or input to its associated marginal valuation (the marginal cost for the output or the marginal value for the input). Moreover, detailed representation of costs with recognition of cost economies is central to the interpretation and use of market power measures.

The most direct way to model and measure market power and cost economies is via a cost function-based model which incorporates pricing equations capturing the differences between output and input market prices and marginal costs or benefits (Morrison, 2001a). To represent the banking firm this study uses the following cost function $c_j(\mathbf{q},\mathbf{w},\mathbf{x},\mathbf{t})$, where $\mathbf{q}$ represents output, $\mathbf{w}$ is a vector of n variable input prices, $\mathbf{x}$ is a vector of input quantities and $\mathbf{t}$ a vector of control and shift variables. The adoption of the intermediation approach leads in this case to the following definition of outputs and inputs: $\mathbf{q}$ is the volume of loans, $\mathbf{w}$ includes the prices of labor, physical capital, materials and other purchased funds, $\mathbf{x}$ represents the volume instead of the price of deposits and $\mathbf{t}$ is a trend variable included to represent the effects of technical change.[11] This cost function facilitates the incorporation of market power for $\mathbf{x}$ that cause the demand equation for this input to have a different structure than that implied by a simple Shephard's lemma condition.

[10] Morrison (2001) develops and applies this empirical model to the US beef packing industry.

[11] In cost function models deposits may be specified as outputs, inputs or as having both input and output attributes. As mentioned in the previous section, in the intermediation approach deposits are treated as inputs. That is, deposits are viewed as (intermediate) inputs, generated by the bank by offering means of payment services to depositors, and used in conjunction with other inputs to originate loans and other earning assets. In contrast, in the production approach deposits are considered as outputs while in the value-added approach deposits are considered to have both output and input characteristics.

A detailed representation of technological aspects such as *scale economies* and *technical change* requires consideration of the functional form of the cost function rather than of the arguments (Morrison, 2001b). In particular, the functional form assumed for $c_j(\mathbf{q,w,x,t})$ should be a second order form that allows not only for the cost-output relationship to be non-proportional, but also to depend on all input prices (implying non-homotheticity if a full set of interaction terms between **q** and the **w** are included). Then, characterising *market power* in the loan and deposit markets requires profit maximisation and potential deviations from competitive markets to be incorporated into the cost function model.

In the output market, the profit maximising output supply decision can be represented by MC=MR where $MC=\partial c_j/\partial q_j$ represents marginal cost and $MR=p(Q)+q_j(\partial p/\partial Q)\cdot(\partial Q/\partial q_j)$ is marginal revenue computed from an inverse demand function p(Q) representing the output demand structure. After some manipulation, this optimality condition can also be presented as:

$$(1) \qquad p_j = -\frac{\lambda_j^q}{\eta} + \frac{\partial c_j}{\partial q_j}$$

where $\lambda^q_j=(\partial Q/\partial q_j)\cdot(q_j/Q)$ is usually defined as the conjectural elasticity of total industry output with respect to the output of the jth firm and $\eta=-(\partial Q/\partial p)/Q$ is the market demand price semi-elasticity (it does not include p). From this condition, the degree of oligopoly power for the jth firm, founded on the classical Lerner index, can be defined as the difference between price and marginal cost and is given by $\theta^q_j=\lambda^q_j/\eta$. Thus, the measure of market power is composed of two parts: the conjectural elasticity and the demand price semi-elasticity. Then, the separate identification of λ^q_j and η requires the simultaneous estimation of (1) along with a demand function from which the parameters necessary for the identification of η can be recovered.

An analogous specification can be constructed for the x input market, since the cost function is expressed in terms of the quantity instead of the price of x. In this case, the profit maximising input demand condition for input x can be expressed as the equality between the marginal factor cost and its revenue marginal product, $MFC^x=w^x(X)+x_j(\partial W/\partial X)\cdot(\partial X/\partial x_j)=[p(Q)+q_j(\partial p/\partial Q)\cdot(\partial Q/\partial q_j)](\partial q_j/\partial x_j)=RMP$ where $w^x(X)$ is the inverse supply function of x. However, if the primal-based RMP is replaced by its dual equivalent $-\partial c_j/\partial x_j$, the cost-side version of the optimal input pricing equation can be expressed as:

$$(2) \qquad w_j^x = -\frac{\lambda_j^x}{\varepsilon} - \frac{\partial c_j}{\partial x_j}$$

where w is the input market price, $\lambda^x_j = (\partial X/\partial x_j)(x_j/X)$ is firm's j conjectural variation elasticity in market X, $\varepsilon = (\partial X/\partial w)/X$ is the industry input supply price semi-elasticity and $-\partial c_j/\partial x_j$ is the marginal shadow price of x for firm j.[12] Then, the differential between marginal and average price measures the degree of oligopsony power, $\theta^x_j = \lambda^x_j/\varepsilon$. For the same reasons as above, estimation of λ^x_j and ε requires adding an input supply function to the model.

The estimating equations for implementation of the model include the cost function, output demand, input supply and pricing equations. The flexible functional form specified for the cost function is the following translog function with fixed effects for regions included through dummy variables:

$$
\begin{aligned}
(3)\qquad \ln c_{jt}(\mathbf{q,w,x,t}) = {} & \alpha_0 + \sum_i \beta_i \ln w_{ijt} + \beta_q \ln q_{jt} + \beta_x \ln x_{jt} + \beta_t \ln t + \frac{1}{2}\sum_i \sum_k \beta_{ik} \ln w_{ijt} \ln w_{kjt} \\
& + \frac{1}{2}\beta_{qq}(\ln q_{jt})^2 + \frac{1}{2}\beta_{xx}(\ln x_{jt})^2 + \frac{1}{2}\beta_{tt} t^2 + \sum_i \beta_{iq} \ln w_{ijt} \ln q_{jt} + \sum_i \beta_{ix} \ln w_{ijt} \ln x_{jt} \\
& + \sum_i \beta_{it} \ln w_{ijt} t + \beta_{qx} \ln q_{jt} \ln x_{jt} + \beta_{qt} \ln q_{jt} t + \beta_{xt} \ln x_{jt} t + \sum_r \alpha_r D_r \qquad j=1,\ldots N,\ t=1,\ldots T
\end{aligned}
$$

where c_{jt} represents total cost, w_{jt} denotes input prices, q_{jt} is the volume of loans and x_{jt} is the volume of deposits for firm j in period t and where subscripts i, k=1,...,4 denote inputs labor, physical capital, materials and other funds. A time trend t is added to serve as an indicator of technological progress and D_r is a dummy variable included to allow for differences across geographical areas. N is the number of banks and T the number of observations per bank, which varies across institutions.

By partially differentiating the cost function with respect to each input price and using Shephard's lemma, the following input share equations are obtained:

$$
(4)\qquad s_{ijt} = \beta_i + \sum_k \beta_{ik} \ln w_{kjt} + \beta_{iq} \ln q_{jt} + \beta_{ix} \ln x_{jt} + \beta_{it} t
$$

where $s_{ij} = \partial \ln c_{jt}/\partial \ln w_{ijt} = x_{ijt} \cdot w_{ijt}/c_{jt}$ is the share of input i in total cost. These cost share equations are estimated along with the cost function to improve efficiency.

[12] A combination of market power for both the output and input side has been expressed as $p(1+\theta^q) = w^x(1+\theta^x) + MC$ by Schroeter (1988). However, stating the optimisation problem in this manner requires restrictive assumptions on the cost structure, in particular fixed proportions andseparability of the *x* input from the others. Also assuming the θ^q and θ^x parameters are equal, suggests the same conjectural variations in both input and output markets, which relies on fixed proportions.

The hypothesis of profit maximisation implies that (3) satisfies the symmetry, linear homogeneity in input prices, monotonicity and concavity properties. A necessary and sufficient condition for the translog cost function to satisfy symmetry is that $\beta_{ik}=\beta_{ki}$ for all k, i. If the cost function is linearly homogeneous in input prices, the share equations will be homogeneous of degree zero in prices. To ensure symmetry and linear homogeneity in input prices, the following parameter restrictions on equations (3) and (4) are imposed: $\Sigma_i \beta_i=1$, $\Sigma_i\beta_{ik}=0$, $\beta_{ik}=\beta_{ki}$, $\Sigma_i \beta_{iq}=0$, $\Sigma_i \beta_{ix}=0$, $\Sigma_i \beta_{it}=0$. Monotonicity and concavity are not general properties of the translog. Unlike symmetry they cannot be conveniently summarised by linear restrictions on parameters of equations (3) and (4). Instead the consistency of the estimated equations with respect to these properties must be evaluated. To satisfy the monotonicity condition, the estimated shares must be positive and for concavity, the bordered Hessian matrix of first and second partial derivatives of the cost function must be negative semidefinite.

The marginal cost function for loans and marginal shadow price function for deposits are obtained from the cost function by partially differentiating c_j with respect to q_j and x_j respectively. As a result, the optimal pricing equations for loans and deposits stemming from (1) and (2) have the form:

(5) $$p_{jt} = \theta^q + \left(\frac{c_{jt}}{q_{jt}}\right)\cdot\left(\beta_q + \beta_{qq}\ln q_{jt} + \sum_i \beta_{iq}\ln w_{ijt} + \beta_{xq}\ln x_{jt} + \beta_{qt}t\right) + \theta^q t + \sum_r \theta_r^q D_r$$

(6) $$w^x_{jt} = \theta^x + \left(\frac{c_{jt}}{x_{jt}}\right)\cdot\left(\beta_x + \beta_{xq}\ln q_{jt} + \sum_i \beta_{ix}\ln w_{ijt} + \beta_{xx}\ln x_{jt} + \beta_{xt}t\right) + \theta^x t + \sum_r \theta_r^x D_r$$

where p_j is the interest rate on loans and w_j^x the interest rate on deposits for firm j, $\theta^q=\lambda^q/\eta$ measures the difference between p and the marginal cost of loans, $\theta^x=\lambda^x/\varepsilon$ represents the gap between w^x and the marginal benefit from deposits, η is the price semi-elasticity of the demand for bank loans and ε the price semi-elasticity of the supply of deposits. Dummy variables D_r are also added to these equations to allow θ^q and θ^x to vary across regions.

In order to estimate η and ε the demand for loans and supply of deposits are specified as log-linear functions of the form:

(7) $$\ln Q_t = \gamma_0 + \eta_p \ln p_t + \gamma_Y \ln Y_t + \gamma_Z \ln Z_t$$

(8) $$\ln X_t = \delta_0 + \varepsilon_w \ln w^x_t + \delta_Y \ln Y_t + \delta_Z \ln Z_t$$

where Q is the aggregate demand for loans and X the aggregate supply of deposits expressed as functions of total income Y, the price of a substitute Z, and the interest rate on loans p_t and deposits w_t respectively. The parameter η_p is the price elasticity of demand for loans and ε_w the price elasticity of supply of deposits. Equations (7) and (8) can be viewed as first-order approximations to arbitrary demand functions.

The complete model consists of equations (3), (4), (5), (6), (7) and (8) and in principle may be estimated as a full system. In practice, however, it has proven to be difficult to estimate and is very demanding of data resources (Huang and Sexton, 1996). For those reasons the loans demand and the deposits supply functions (7) and (8) are estimated separately from quarterly time-series data while the cost function, input cost share and pricing equations are estimated as a system using annual bank-level data.

Market power and cost efficiency

From equations (5) and (6) different measures of market power can be constructed from the estimated parameters θ^q_j and θ^x_j. The degree of oligopoly and oligopsony power of the jth firm can be measured as: $\tau_{qj}=(p_j-\partial c_j/\partial q_j)/p_j=\theta^q_j/p_j$ for the loans market and $\tau_{xj}=(w^x_j-\partial c_j/\partial x_j)/(\partial c_j/\partial x_j)$ $=\theta^x_j/(\partial c_j/\partial x_j)$ for the deposits market, where the overall deviation from zero indicates the presence of market power.[13] In addition, the conjectural elasticity λ can be estimated as $\lambda^q=\theta^q_j\cdot\eta$ for the loans market and $\lambda^x=\theta^q_j\cdot\varepsilon$ for the deposits market, where $\lambda^q>0$ and $\lambda^x>0$ imply effective oligopoly and oligopsony power. From equations (5) and (6) market power indicators τ can be obtained by dividing the parameter θ^q by the average interest rate on loans and θ^x by the average marginal shadow price of deposits. The parameters λ^q (λ^x) can also be estimated by multiplying θ^q (θ^x) by the price semi-elasticity of demand (supply) for loans (deposits) obtained from (7) and (8).

As indicators of cost efficiency, scale economies and time elasticities, often interpreted as technological change, may also be derived. These measures represent the cost changes associated with scale Q and technical t changes, or the cost-output relationship on a given cost curve and a shift in the cost function between two time periods, respectively. Scale economies are defined as $SCE=(1-\varepsilon_{CQ})$ where $\varepsilon_{CQ}=\partial \ln c_j/\partial \ln q_j$ is the total cost elasticity, which can be estimated by partially differentiating the translog cost function as follows:

[13] In addition, these firm-based measures may also be used to define the industry output and input market power indicator founded on the classical Lerner index that is defined as $L_q=\sum\tau_{qj}S_j$ and $L_x=\sum\tau_{xj}S_j$ where S_j is the market share of firm j.

(9) $$\varepsilon_{CQ} = \partial \ln c_j / \partial \ln q_j = \beta_q + \beta_{qq} \ln q_j + \sum_i \beta_{iq} \ln w_{ij} + \beta_{xq} \ln x_j + \beta_{qt} t$$

where $\varepsilon_{CQ}<1$ indicates the presence of economies of scales and $\varepsilon_{CQ}>1$ implies the existence of scale diseconomies. The time elasticity is defined as $\varepsilon_{CT}=\partial \ln c_j/\partial t$ and can be estimated with this expression:

(10) $$\varepsilon_{CT} = \partial \ln c_j / t = \beta_t + \beta_{tt} t + \sum_i \beta_{it} \ln w_{ij} + \beta_{qt} \ln q_j + \beta_{xt} \ln x_j$$

where $\varepsilon_{CT}<0$ indicates the contribution of technological change in reducing banking costs. These indicators represent the fundamental cost economy measures embodied in this study.

5. Empirical Implementation and Results

Data and Variables

The data for estimation of the system of equations (3), (4), (5) and (6) consists of annual information from the Report of Condition and Income Statement of each retail bank over the period 1993-2000.[14, 15, 16] The banks in the sample are classified into three different size bands (large, medium and small) based on bank asset values in 1993. Banks with more than \$700 million of total assets are classified as large banks. Medium- and small-sized institutions are those with total assets between \$700 and \$150 million and less than \$150 respectively. According to this classification the following dummy variables D_L, D_M and D_S take value 1 for large, medium- and small-sized banks respectively and 0 otherwise.

Banks are also clustered in four separate markets (Centre, North, South and National) according to their prevailing area of business. The country is partitioned in three areas: Centre, North and

[14] Of special interest from the standpoint of competition analysis is the retail banking industry, which serves households and small businesses. Wholesale commercial banking is essentially a distinct industry wherein large banks provide a wide range of sophisticated services to large corporate customers. Retail banking is then more likely than wholesale banking to be subject to market power due to information asymmetries between buyers and sellers, switching costs, and the prevalence of local rather than national or international markets.

[15] Even though the Argentine financial system is made up of both bank and non-bank financial institutions, the analysis deals with only the banking industry. Non-bank financial institutions generally represent small saving and credit unions as well as specialised financial companies and throughout the decade, the total number has never been above 50 and accounted for only 2% of the system's assets.

[16] The data were obtained from the Central Bank of Argentina. The data for the period 1993-1997 were provided by the Central Bank with the consent that the identity of the different banks cannot be inferred from the statistics and results reported in this study.

South (comprising the following provinces, in the order: Buenos Aires, Capital Federal, Córdoba, Santa Fe, Entre Ríos, Mendoza, San Juan, San Luis and La Pampa; Misiones, Corrientes, Formosa, Chaco, Jujuy, Salta, Tucuman, Santiago and La Rioja; and Neuquén, Río Negro, Chubut, Santa Cruz and Tierra del Fuego). Each bank is considered to belong to a certain area if it collects at least 70% of its deposits in that area. As the threshold is increased, the criterion tends to move banks with an area-wide outreach to the nation-wide category.[17] The following dummy variables are defined according to this criteria D_{Ce},, D_{No}, D_{So} and D_{Na} which equal 1 for banks in Central, Northern, Southern and National regions respectively and 0 otherwise.

The definition of outputs and inputs follows the intermediation approach. Thus, q is measured as the volume of loans and x as the volume of deposits while the interest rates on loans p and deposits w^x are given by the ratios of interests on loans to total loans and interest paid on deposits to total deposits respectively.[18] Since loans are denominated in domestic (pesos) and foreign (dollars) currency, a quantity index is constructed by Divisia aggregation of loans in pesos and dollars as follows: $\ln q^t - \ln q^{t-1} = (1/2)\Sigma_i(s_i^t + s_i^{t-1})\cdot(\ln q_i^t - \ln q_i^{t-1})$ where q_i represents the ith type of loan, p_i the interest rate, $s_i = p_i \cdot q_i / \Sigma_i p_i \cdot q_i$ its share in total revenues, q the aggregate and the superscript t represents the time period.[19] A Divisia quantity index of deposits (in pesos and dollars) is also constructed using the same methodology. Finally interest rates on loans and deposits are estimated by dividing the interests paid on loans and interest earned on deposits by the corresponding quantity indexes.

The prices for the four inputs (labor, capital, materials and other funds) are computed as follows. The wage rate (w_l) is proxied by the ratio of personnel expenses (wages, insurance payments and subcontracted services cost) to the number of employees in the respective bank. The price of capital in each bank (w_k) is generated as sum of the depreciation rate and the opportunity cost of capital. The latter is approximated by the interest rate for loans less the expected rise in the value of the investment goods employed, which is proxied by the growth

[17] Since information on deposits per bank per area is only available for the period 1998-2000, each bank is assumed to maintain during 1993-1997 the same distribution of deposits as in 1998

[18] Because the price data are subject to error from this estimation procedure, observations in which the prices on loans and deposits are more than 2.5 standard deviations from the mean value for that year are dropped.

[19] Loans denominated in domestic and foreign currency represent related products with different prices. If a measure of output is constructed by simply adding up the volume of each type of loan, it will represent the stock of loans instead of the value of the monetary services that banks provide through them. Consequently, a common practice consists of aggregating them using aTornqvist index that is a discrete approximation to a Divisa one. The Divisia index in differential form is given by $dlnq=\Sigma_i s_i \cdot d\, lnq_i$, and the discrete approximation used here for time series data take this form: $lnq^t - lnq^{t-1} = (1/2)\Sigma_i(s_i^t + s_i^{t-1})\cdot(lnq_i^t - lnq_i^{t-1})$.

rate of the wholesale price index.[20] The price of materials (w_m) is constructed as administrative expenses minus personnel and capital costs divided by the value of total assets. The price of other funds in each bank (w_f) is given by the ratio of interest expenses on other purchased funds to other borrowed funds (including interbank and federal funds purchased, commercial papers and other purchased funds). Total cost in each bank (C) includes all operating expenses and interest payments on other funds. All data were converted into 2000 prices using the wholesale price index. Mean values for the cost, input and output variables are presented in table 4.

Table 4

Description of the data (mean values)

Variable		1993	2000	Large	Medium	Small
Assets (million $)		493.5	2,659.9	4,520.1	592.4	125.8
Loans (million $)	q	308.3	1,490.2	2,715.5	386.9	91.7
Deposits (million $)	x	216.9	2,137.0	2,012.8	501.0	80.3
Interest rates (%)						
Loans	p	23.7	17.9	16.9	19.2	23.8
Deposits	w^x	9.8	6.2	7.0	8.2	10.5
Other input prices (%)						
Labor (thousand $ per employee)	w_l	27.2	30.3	36.4	29.2	27.4
Capital	w_k	32.8	18.4	21.1	23.8	28.3
Materials	w_m	4.3	3.3	2.1	3.3	4.4
Funds	w_f	4.5	3.3	3.3	3.2	3.5
Total costs (million $)	C	53.2	116.2	280.1	55.1	13.9
Input cost shares (%)						
Labor	s_l	46.1	44.3	46.7	45.5	43.9
Capital	s_k	17.5	12.9	13.2	14.3	16.5
Materials	s_m	28.1	34.9	25.2	30.4	33.4
Funds	s_f	8.3	7.8	14.9	9.9	6.2
Number of banks*		129	52	20 (13)	43 (18)	65 (20)

Constant pesos December 2000. * Number of banks in 1993 (2000) respectively.

The data for estimation of equations (7) and (8) consist of quarterly industry-level data for the period 1994-2000. The aggregate volume of loans (Q) and deposits (X) and the average interest rate on loans (p) and deposits (w^x) estimated as the ratio of interest on loans/deposits over total loans/deposits were obtained from the Banco Central de la República Argentina (2001). The activity level (Y) is proxied by the GDP and the price of a substitute (Z) is estimated as sum of the LIBOR rate and the level of sovereign risk reflected in the price of the FRB bonds issued by the Argentine government. This information was obtained from the Ministerio de Economía y Obras y Servicios Publicos (2001).

[20] An alternative definition for w_k (i.e. the ratio of net expenses on property and equipment to the net value of these items) was also tried, however the results were robust to this alternative specification.

Empirical Results

The demand for loans and supply of deposits were estimated by Two Stage least Squares (2SLS), because of the endogeneity of p and w^x, using industry-level data. The estimated functions are:

(11) $\ln Q_t = 3.359 - 1.359 \ln p_t + 0.494 \ln Y_t + 0.513 \ln Z_t$ DW= 1.56

(0.39) (-2.53) (1.66) (3.47)

(12) $\ln X_t = -45.985 + 1.756 \ln w^x_t + 4.926 \ln Y_t$ DW= 1.49

(-3.80) (1.95) (4.47)

where *t* statistics are indicated in parenthesis. All the coefficients have the expected signs and are statistically different from zero at significance levels of 5% (except the constant term in the demand equation). Moreover, based on the Durbin-Watson statistic the hypothesis of noncorrelated disturbance terms can not be rejected. The price elasticity of demand for loans and supply of deposits equals η_p=-1.359 and ε_w= 1.756 suggesting that depositors appear to be more responsive than borrowers to variations in interest rates. [21]

The system based on the cost function, input shares and pricing equations was then estimated on the basis of the firm-level data for the entire sample and also over three subsets of data using large, medium- and small-sized banks respectively.[22] Additive error terms were appended to each equation and linear homogeneity in input prices and symmetry restrictions imposed across equations. The system was estimated by Iterative Three Stage Least Squares (I3SLS) to take into account the joint endogeneity of prices and quantities in the loans and deposits markets that may be characterised by noncompetitiveness. The results presented in table 5 show that most of the estimated parameters are statistically different from zero at significance levels of 10% or less i.e. twenty-nine of the forty coefficients are statistically significant in the complete sample estimation and more than three fourths in the case of the subsamples. [23]

[21] Although other formulations incorporating interaction terms were attempted, none of these attempts proved successful.

[22] McAllister and McManus (1993) noted that the fitting of atranslog cost function over a population of banks that varies widely in terms of size and output mix may result in specification bias and suggested the use of restricted samples of banks that are similar in output mix and prices. The sample of Argentine banks presents markedly differences in terms of size (measured by the value of total assets) and output composition. While small banks provide credit to households and small firms, large banks specialise in more sophisticated products and provide financing to large firms.

[23] The values of the restricted parameters were calculated by using the symmetry and linear homogeneity restrictions imposed.

Table 5

Parameter estimates: cost function, input share equations and pricing equations (3 - 6)

	Overall sample – excluding dummies		Subsamples – including regional dummies					
			Large		Medium		Small	
Parameter	coef	t value	coef	t value	coef	t value	Coef	t value
α_0	2.535*	13.56						
β_l	0.690*	15.00	0.869***	1.77	0.804*	4.71	0.532*	12.06
β_k	0.040*	2.35	-0.008	-0.20	0.037***	1.07	0.251*	8.42
β_m	0.258*	15.34	0.061	1.33	0.188*	6.24	0.224*	6.05
β_f	0.012	1.02	0.078***	1.82	-0.030	-0.83	-0.007	-0.34
β_q	0.819*	11.65	1.005*	4.91	1.353*	12.76	1.986*	17.79
β_x	-0.150*	-2.80	-0.239*	-3.33	0.092	0.88	-0.433*	-4.04
β_t	0.067	1.49	0.228*	3.01	0.269*	3.50	0.271*	3.47
β_{ll}	0.101*	15.74	0.158*	9.71	0.084*	9.46	0.076*	7.70
β_{kk}	0.070*	12.28	0.076*	9.80	0.045*	5.20	0.050*	6.12
β_{mm}	0.114*	21.18	0.148*	16.30	0.088*	13.78	0.137*	14.27
β_{ff}	0.026*	13.33	0.061*	10.73	0.020*	5.64	0.025*	10.69
β_{lk}	-0.040*	-9.10	-0.048*	-5.27	-0.035*	-5.22	-0.012**	-1.90
β_{lm}	-0.057*	-12.19	-0.090*	-9.67	-0.050*	-8.80	-0.065*	-7.96
β_{lf}	-0.004***	-1.65	-0.019*	-2.52	0.001	0.39	0.001	0.33
β_{km}	-0.032*	-7.66	-0.022*	-3.51	-0.013**	-2.28	-0.042*	-6.45
β_{kf}	0.003***	1.63	-0.005	-1.27	0.003	1.11	0.004	1.49
β_{mf}	-0.025*	-12.62	-0.036*	-8.21	-0.024*	-9.63	-0.029*	-9.33
β_{qq}	0.036**	1.88	-0.039	-1.25	0.001	0.01	-0.250*	-4.74
β_{xx}	0.061*	3.53	-0.034***	-1.59	-0.037	-1.27	-0.003	-0.08
β_{tt}	-0.007	-0.89	-0.002	-0.24	-0.015	-1.42	-0.007	-0.56
β_{lq}	-0.055*	-7.20	-0.015	-1.08	-0.063*	-5.28	-0.047*	-3.58
β_{kq}	0.003	0.63	0.021*	2.87	0.009	0.95	-0.038*	-4.28
β_{mq}	0.008	1.27	-0.019**	-2.21	0.005	0.64	0.021	1.67
β_{fq}	0.043*	8.76	0.014***	1.76	0.048*	4.74	0.064*	8.78
β_{lx}	0.038*	5.19	-0.034*	-2.61	0.020**	2.00	0.048*	3.85
β_{kx}	-0.014*	-2.72	-0.026*	-3.25	-0.012	-1.50	-0.015**	-1.84
β_{mx}	0.004	0.64	0.063*	7.84	0.014**	1.91	0.017	1.45
β_{fx}	-0.028*	-5.90	-0.003	-0.39	-0.023*	-2.78	-0.050*	-7.44
β_{lt}	-0.016*	-7.60	-0.007	-1.42	-0.009*	-3.16	-0.013*	-3.70
β_{kt}	0.006*	4.33	0.007*	3.17	0.007*	3.09	0.008*	3.65
β_{mt}	0.009*	5.23	0.000	0.14	0.006*	2.76	0.000	-0.01
β_{ft}	0.001	0.50	-0.001	-0.21	-0.004	-1.41	0.005*	2.45
β_{xq}	-0.023	-1.38	0.051*	3.59	-0.026	-0.80	0.075**	2.05
β_{qt}	-0.005	-0.53	-0.020***	-1.82	-0.047*	-3.45	-0.061*	-4.13
β_{xt}	-0.008	-1.16	-0.008***	-1.73	0.017**	2.06	0.011	1.04
α_{rc}			2.166*	2.94	0.115	1.49	-0.188*	-3.24
α_{rne}					0.078	0.76	-0.069	-0.85
α_{rnw}					-0.150***	-1.59	0.246	1.52
α_{rw}			2.190*	2.92				
θ^q	0.061*	4.98						
θ^q_{Ce}			0.048*	3.27	0.027*	3.06	0.077*	7.30
θ^q_{No}					0.070*	3.90	0.073*	3.82
θ^q_{So}					0.043*	2.68	0.051	1.13
θ^q_{Na}			0.018***	1.30				
t	0.001	0.33						
θ^x	0.111*	10.29						
θ^x_{Ce}			0.032*	7.44	0.045*	8.50	0.091*	9.22
θ^x_{No}					0.045*	4.54	0.059*	3.27
θ^x_{So}					0.043*	5.18	0.034	0.81
θ^x_{Na}			0.031*	7.12				
t	-0.006*	3.03						

*, **, *** coefficient significant at 1, 5 and 10% level. Regions: Ce=central, No=north, So=south, Na=national.

In order to explore the cost function properties, several regularity conditions were tested in addition to the linear homogeneity in input prices and symmetry imposed *a priori* during estimation. Monotonicity in output and input prices was satisfied since the fitted cost shares s_i and marginal costs were positive for almost all observations.[24] Concavity in input prices was apparently satisfied because the bordered Hessian matrices computed using the fitted input share equations and the relevant parameter estimates were negative semidefinite at almost all data point.[25] Finally, the estimated costs were positive for all values of output satisfying the non-negativity condition, and continuity followed from the flexible functional form employed.

Table 6

Structural tests of the cost function

Restrictions	Likelihood Ratio test statistic: Full sample	Subsamples: Large	Medium	Small	Number of restrictions	Chi-square*
(i) Hotheticity $\beta_{iq}=0$	89.63	25.68	31.55	50.81	3	11.34
(ii) Homogeneity in output $\beta_{iq}=0$, $\beta_{qq}=0$	93.35	27.21	32.08	52.35	4	13.28
(iii) Unitary elasticity of substitution $\beta_{ik}=0$	551.66	232.56	191.30	210.29	6	16.81
(iv) Generalised Cobb-Douglas $\beta_{iq}=0$, $\beta_{qq}=0$, $\beta_{ik}=0$	650.48	275.65	239.79	258.78	10	23.21

* Critical values at 1% level

Additional restrictions were then imposed on the parameters of the translog cost function in order to investigate the production structure of the industry. Four hypotheses were tested: (i) homotheticity (the cost function can be written as a separable function in output and factor prices, $\beta_{iq}=0$), (ii) homogeneity with respect to output (the elasticity of cost with respect to output is constant, $\beta_{iq}=\beta_{qq}=0$), (iii) unitary elasticity of substitution between inputs ($\beta_{ik}=0$) and (iv) generalised Cobb-Douglas (unitary elasticity of substitution together with homogeneity, $\beta_{iq}=\beta_{qq}=\beta_{ik}=0$). The results of the structural tests of the cost function presented in Table 6 indicate that each restricted functional form of the production technology is strongly rejected. In all cases, the likelihood ratio test statistic exceeded the chi-square critical value at 1% significance level suggesting that the use of the translog flexible functional form to estimate the cost structure appears to be appropriate.

[24] The monotonicity in input prices was violated in no more than 3% of the cases whilemonotonicity in output was satisfied for all observations.

[25] The second minor presented the wrong sign, a result that could be a consequence of limited substitution possibilities among inputs that characterises the banking industry technology. In fact, the average Allen elasticities of substitution computed at the sample mean (for the overall sample estimation) were 0.082 for

Although most of the parameters are not readily interpretable individually, some relevant implications about market power are evident from the q and x pricing equation estimates presented in the last rows of Table 5. On the one hand, the parameter θ^q (positive and highly significant) indicates that banks seem to price above marginal cost in the loans market. On the other, the coefficient θ^x (also statistically significant and positive) suggests that banks would not be paying the full value of their marginal benefit for increases in deposits, implying a possible exploitation of oligopsony power in this market. However, more direct assessment of market power requires evaluating the τ estimates that are presented in table 7 for the average bank and that were obtained dividing the parameter θ^q by the average interest rate on loans and θ^x by the average marginal shadow price of deposits, in both cases, for the overall sample or subsample.

Table 7

Market power and cost efficiency measures

Category	Loans		Deposits		Cost elasticity		Time elasticity	
	θ^Q	τ_Q	θ^x	τ_x	Mean	Std error	Mean	Std error
All banks	*0.064**	*0.323**	*0.084**	*0.359**	*0.907**	*0.028*	*-0.016*	*0.012*
93-96	0.062*	0.285*	0.102*	0.417*	0.921*	0.030	-0.012	0.022
97-00	0.065*	0.362*	0.079*	0.349*	0.882*	0.034	-0.060*	0.016
Large banks	*0.033**	*0.185**	*0.032**	*0.313**	*1.056**	*0.028*	*0.013*	*0.016*
Centre	0.048*	0.241*	0.032*	0.316*	1.067*	0.037	0.029	0.016
National	0.018***	0.129***	0.031*	0.311*	1.044*	0.041	0.001	0.016
Medium banks	*0.047**	*0.240**	*0.044**	*0.377**	*0.974**	*0.042*	*0.049**	*0.015*
Centre	0.027*	0.145*	0.045*	0.349*	1.018*	0.039	0.036*	0.013
North	0.071*	0.313*	0.045*	0.386*	0.973*	0.081	0.093*	0.022
South	0.043*	0.262*	0.043*	0.397*	1.008*	0.035	0.049*	0.013
Small banks	*0.067**	*0.385**	*0.061**	*0.460**	*0.902**	*0.041*	*0.039**	*0.018*
Centre	0.078*	0.336*	0.091*	0.458*	0.847*	0.042	0.028	0.015
North	0.073*	0.397*	0.059*	0.481*	0.851*	0.048	0.031*	0.014
South	0.051	0.422	0.034	0.441	0.516*	0.059	-0.031	0.022

*, **, *** coefficient significant at 1, 5 and 10% level.

As Table 7 shows, the estimated value of τ_q for the average bank is 32.3%, indicating that banks are pricing one third above marginal cost, and the average margin rose over the sample period from 28.5 to 36.2%, probably as a consequence of the consolidation process described above. Moreover, the estimated values of τ_q for large, medium- and small-sized banks are 18.5, 24.0 and 38.5% respectively, which suggests that small banks seem to exercise a higher degree of market power pricing than larger financial institutions. This result could be explained by the differences in output mix among banks in different size bands: while small-sized banks finance

labor-capital, 0.12 for labor-materials, 0.183 for labor-funds, 0.007 for capital-materials, 0.01 for capital funds and 0.001 for materials-funds.

households and small firms, large financial institutions provide credit to major corporations. In this latter case, countervailing power could mitigate market power leading to large banks exerting a lower degree of oligopoly power than smaller institutions. Finally, and even though the average τ_q differs across regions, small-sized banks present the highest τ values in all cases.

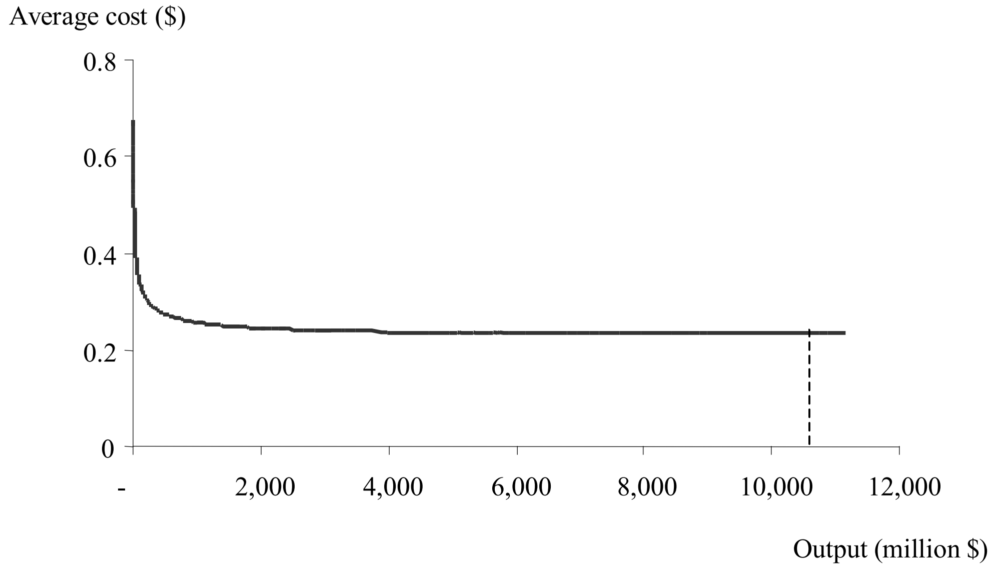
For the deposits market the average τ_x measure is 35.9% indicating the exercise of market power pricing by the average bank. The results also show that this margin dropped over the sample period from 41.7 to 34.9%. The estimated value of τ for large, medium- and small-sized banks that reaches 31.3, 37.7 and 46.0% respectively, presents the same pattern as in the loans market where smaller financial institutions exercise more market power than dominant banks and the same explanation could probably be addressed here. These results also indicate that banks exert a higher degree of market power pricing in the deposits market which may be explained by the fact that depositors, specially small firms, farmers and households, may have limited access to overseas financial markets, thus representing a captive market for domestic financial institutions. Finally, the average τ_x also differs across regions.

The interpretation of these indicators of market power is reinforced by considering the associated evidence of cost economy measures presented in Table 7. The cost elasticities measures were obtained by setting the variables in (9) equal to their average value of the total sample or subsample. The estimated value for the overall sample $\varepsilon_{CQ} = 0.907$ suggests the presence of significant economies of scale which have increased over the sample period since ε_{CQ} rose from 0.921 in 1993-1996 to 0.882 in 1997-2000, possibly due to the adjustment time needed to respond to the great expansion in demand for banking services. The cost curve facing the average firm plotted in Figure 1 and derived by evaluating the average cost function for a range of outputs while holding the factor prices fixed at the sample means, is a useful way to summarise these results. [26]

The results also show that scale economies diminish as firm size increases since for large banks the estimated ε_{CQ} indicates significant decreasing returns to scale while for medium- and small-sized institutions reveal the presence of significant scale economies. The shape of the average cost curve depicted in Figure 1 confirms these findings because: banks with less than \$2.0 billion of output (medium and small-sized) operate in the decreasing section of the cost curve while banks with higher output levels (large) appear to operate in its flat / increasing segment. These results suggest that medium- and small-sized banks could exploit economies of scale by increasing their sizes. This evidence in turn could probably been indicating that the average size of banks in Argentina has not reached the efficient scale and consequently that size should be increased in order to reach the point of minimum average costs.

Figure 1

Average cost curve



Finally, Table 7 also presents the estimates of time elasticities aimed at capturing the contribution of technical change in reducing average banking costs and obtained by setting the variables in (10) equal to their average value of the total sample or subsample. The estimated value for the overall period $\varepsilon_{CT} = -0.016$ seems to suggest that technical change has not played a statistically significant role in the reduction of average costs of Argentine banks, at least during the early period. However, some evidence of significant cost savings appears in the later period for which $\varepsilon_{CT} = -0.06$. The results also indicate that the effect of technical change on average costs is not significantly different from zero for large institutions while for the group of medium- and small-sized banks is positive and statistically significant. However, the time elasticity computed for the later period suggests that large, medium- and small-sized institutions experienced cost savings as a consequence of technological progress. This result could be connected to the fact that new technology, such as the 'Automatic Teller Machines' or information systems technologies, was gradually introduced over the nineties.

[26] The slope of the average cost curve is sufficient to infer the presence of scale economies since SCE=1-(marginal cost/average cost). Thus, declining unit costs indicate economies of scale and rising unit costs indicate diseconomies.

Welfare Analysis

The change in social welfare induced by the transformation of the banking sector is now evaluated in a partial equilibrium framework by adding up the changes in aggregate consumer and producer surplus. The aggregate consumer surplus is measured by the compensating variation defined as $CV(p)=e(p^1,v^0)-e(p^0, v^0)$, where $e(p, v)$ is the expenditure function, $v(p, y)$ represents the indirect utility function, p is the price vector and y represents monetary income. When prices decline $p^1 < p^0$, CV is the negative of the area to the left of the Hicksian demand curve for base utility level v^0 between p^1 and p^0, and when $p^1 < p^0$, CV is positive and simply equal to that area, that is, $CV(p)=\int_{p0}^{p1} x^H(p, v^0)dp$ where x^H is the Hicksian demand (Jehle and Reny, 2001).[27]

Breslaw and Smith (1995) show that when prices change from p^0 to p^1, expanding the expenditure function in a Taylor series about (p^0, v^0) and disregarding other terms than the quadratic yields:

$$\text{(13)} \qquad CV(p) = x^H(p^0, v^0)\cdot(p^1 - p^0) + 0{,}5\frac{\partial x^H(p^0, v^0)}{\partial p}(p^1 - p^0)^2$$

and since at the initial equilibrium $x^H(p^0,v^0)=x^M(p,y)$, the derivative of the Hicksian demand can be obtained from the Slutsky equation as $\partial x^H(p^0,v^0)/\partial p = [\partial x^M(p^0,v^0)/\partial p] + x^H\cdot[\partial x^M(p^0,v^0)/\partial y]$ where x^M is the Marshallian demand function. To compute the compensating variation they developed a numerical algorithm that involves splitting up the price change into smaller intervals, evaluating the CV for each small change using (13) and finally adding together the CV computed at each step. This numerical algorithm can be easily implemented and is valid for any demand function.

The aggregate producer surplus or aggregate profit $\Pi(p)$ equals the area between the market price and the industry marginal cost, and can be measured as follows:

$$\text{(14)} \qquad \Pi(p) = \int_0^{x(p^*)} [p^* - c'(x)]\, dx$$

[27] Exact measures of consumer surplus are computable at least theoretically from the knowledge of the ordinary demand curve (Hausman, 1981). Indeed, from Roy's identity, the indirect utility function, the expenditure function and therefore the Hicksian demand function can be recovered. However, this method can be extremely difficult to implement since it involves solving a differential equation that depends on the ordinary demand function, and this is analytically possible only in simple cases. An alternative methodology to approximate welfare measures is to use numerical methods. Vartia (1983) proposed a numerical algorithm to compute the compensated income from any ordinary demand function. Breslaw and Smith (1995) improved on Vartia's method and proposed a quicker algorithm.

where c'(x) represents marginal cost. This producer surplus can be estimated as the difference between total revenue and total cost for the equilibrium level of output. Finally, the change in total surplus dW(p) can be measured as sum of CV(p) and dΠ(p).

In order to compute the welfare effects of market power in the banking industry the equilibrium price (p*) and quantity (Q*) were obtained by solving the model for the overall period 1993 – 2000 and for two sub-periods: 1993 – 1997 and 1997 - 2000. For the early period the equilibrium interest rate and volume of loans were 23.8% and $32.3 billion, for the later 19.0% and $49.7 billion and for the overall 22.1% and $38.5 billions respectively, as Table 8 shows. The model was then also solved, assuming that the parameter of market power equals zero, in order to measure the welfare level that would be associated to a competitive market structure. The last row of Table 8 shows that in this case p* would decline to 15.7% while Q* would reach $61.2 billion.

Table 8

Welfare effects of market power (million $)

Equilibrium	Lerner Index (%)	p* (%)	Q*	Average cost ($)	CV	d Π	d W
Imperfect competition							
Overall period	32.3	22.1	38,521	0.163	1,968	850	2,819
Sub-period 1993-1997	28.5	23.8	32,300	0.179			
Sub-period 1997-2000	36.2	19.0	49,691	0.134			
Perfect competition							
Overall period	0	15.7	61,248	0.157	3,192	-2,238	954

Positive (negative) numbers represent welfare gains (losses).

On the basis of those equilibrium prices and quantities, the changes in welfare associated with two scenarios were obtained by adding the compensating variation, computed applying Breslaw and Smith's algorithm with 300 steps, and the change in profits, estimated as the difference between total revenue and total cost. Under the first scenario, the variation of consumers' and producers' surpluses, as measured by the compensating variation and banks' profits, owed to the increase in the Lerner index from 28.5% to 36.2% was estimated. In the second, the change in economic welfare associated with the observed equilibrium corresponding to the overall period where L = 32.3% and the simulated competitive market where L = 0 was computed.

The results presented in the last three columns of Table 8 show an increase in the compensating variation of $1,9 billion and in banks' profits of $0,8 billion in the first scenario, which represents one fifth and almost one tenth of total annual revenues respectively and imply an increase in economic welfare of $2,8 billion. These results could be explained by the cost economies that apparently led to lower average costs as a consequence of the expansion of banking activity and also the effect of technological change, which may have counteracted the effect of the increase in market power. The second scenario suggests that the cost in terms of economic welfare of the actual industry structure as compared to a competitive one is $1 billion. This result is obtained by summing the compensating variation of $3,2 billion that consumers would receive in a competitive market and the reduction of $2,2 billion in banks' economic benefits. Additionally, a similar result would be obtained if instead of reducing market power, bank activity is expanded in order to fully exploit cost economies (and reduce average costs and interest rates).

6. Conclusions

This study estimates a cost-function based model incorporating output- and input-market pricing decisions to evaluate the market and cost structure of the Argentine banking industry during the nineties. The model is based on a flexible translog cost function that allows a detail representation of technological aspects such as scale economies and technical change, and also on pricing equations for loans- and deposits-markets that allows the measurement of market power in these markets. The model is estimated using bank-level data for Argentine retail banks over the period 1993-2000.

The results suggest evidences of market power pricing in the loans segment, which increased during the period possibly due to the consolidation process. The measures also indicate the possible exploitation of oligopsony power in the deposits market though in this case it apparently decreased over time. These findings also denote a higher level of market power exertion in deposits, which may be a consequence of limited access to international financial markets from depositors, specially small firms, farmers and households. Additionally, these evidences seem to suggest that small-sized banks exert a higher degree of market power pricing than larger institutions, which may be explained by the differences in output mix among banks of different size.

These indications of market power pricing seem to be related to cost economies. In fact, the measures of cost elasticity suggest the presence of significant scale economies for medium- and small-sized banks while slight diseconomies for larger financial institutions. The findings also suggest that technological change contributed to lower banks' production costs during the late nineties, with all banks enjoying a similar percentage of cost savings. These evidences indicate that there still exist economies that can be exploited by an increase in the size of the smaller institutions and in turn points out that the average size of banks in Argentina has to expand in order to reach the efficient scale.

The implications of the cost and market structure patterns on economic welfare, evaluated in a partial equilibrium framework, suggest that both consumers and banks benefited over the period. In fact, the results indicate that consumers' surplus and banks' profits increased over the nineties, possibly due to the expansion of banking activity and also the effect of technological change on average costs, which may have counteracted the effect of market power. Nevertheless, the evidences also suggest that additional benefits would accrue to consumers from a reduction in market power or a further expansion in bank activity level to fully exploit cost economies.

Finally, these findings seem to indicate that market power has been more than off set by the efficiency gains observed over the nineties, since both consumers and banks have benefited in terms of economic welfare gains. These results imply then that policies forcing downsizing in industries characterised by high concentration levels may be misdirected if consolidation and resulting concentration are motivated by cost economies. Obviously, such action could limit the potential to lower costs in the industry, and thus ultimately reduce the product price for consumers.

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